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Geochemical evolution of arsenic affected groundwater in the Jianghan Plain, central China – Using multivariate statistics and geochemical modeling

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A hydrogeochemical study was carried out in the late Pleistocene- Holocene porous aquifer system of the Jianghan Plain, central Yangtze River Basin, China. A total of 457 samples (surface water and groundwater) were collected over a 1,500 km2 study area during the rainy seasons (2014-2015). A combined approach of hydrogeochemical analysis, multivariate statistical methods involving hierarchical cluster analysis (HCA) and principal component analysis (PCA), and inverse geochemical modeling was performed to classify the samples, and to identify major processes controlling groundwater geochemistry. The results show HCO_3-Ca-(Mg) type water predominates in the study area. About 67% of the groundwater samples have arsenic (As) concentrations above the World Health Organization (WHO) standard of 10 μg L-1. The major components (e.g. Ca, Mg and HCO_3) in surface water and groundwater originate from carbonate and silicate weathering. Strongly reducing conditions are mainly responsible for geogenic Fe, As enrichment in the shallow confined groundwater. Anthropogenic activities primarily cause high levels of Cl and SO4 in the surface water and phreatic groundwater. Those results improve the understanding of groundwater flow and geochemical evolution under the impacts of periodic hydraulic fluctuation, water-rock interaction, and anthropogenic activities.